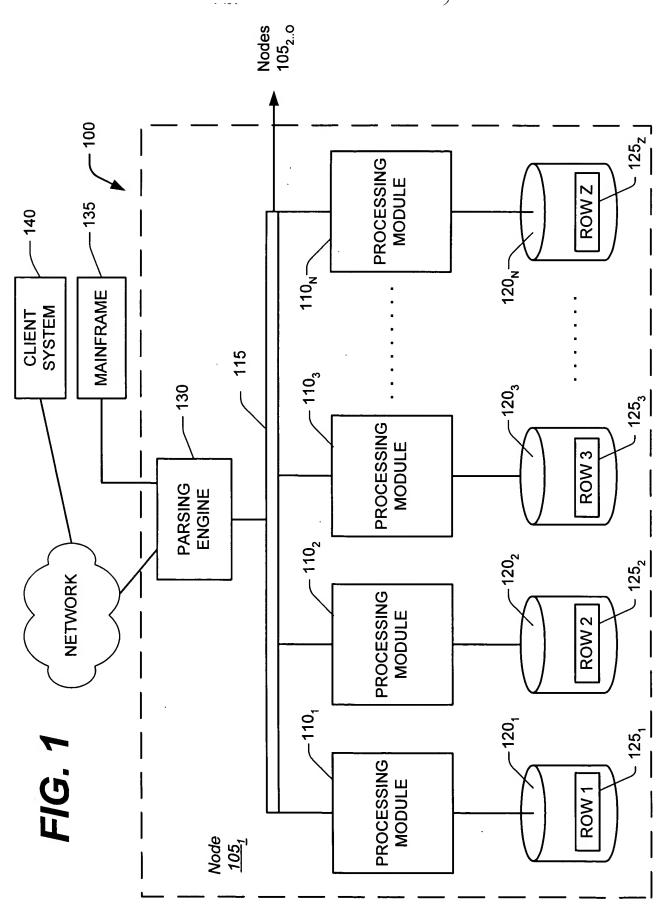Express Mail #EV339227785US
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Sheet 1 of 14

FIG. 1

SQL
QUERY

130

SESSION CONTROL

200

PARSER

205

DISPATCHER

210

FIG. 2

SQL QUERY

205

INTERPRETER

300

SYNTAX CHECKER

305

SEMANTIC CHECKER

310

DATA DICTIONARY CHECKER

315

SCAN(TREE, CLAUSE TYPE)

320

OPTIMIZER

325

EXECUTABLE STEPS

FIG. 3

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FIG. 4A

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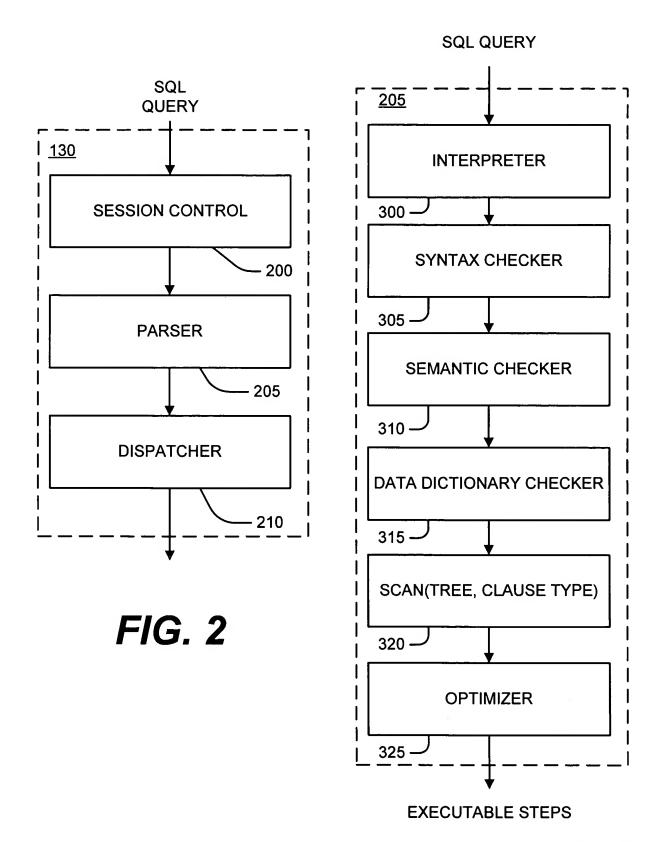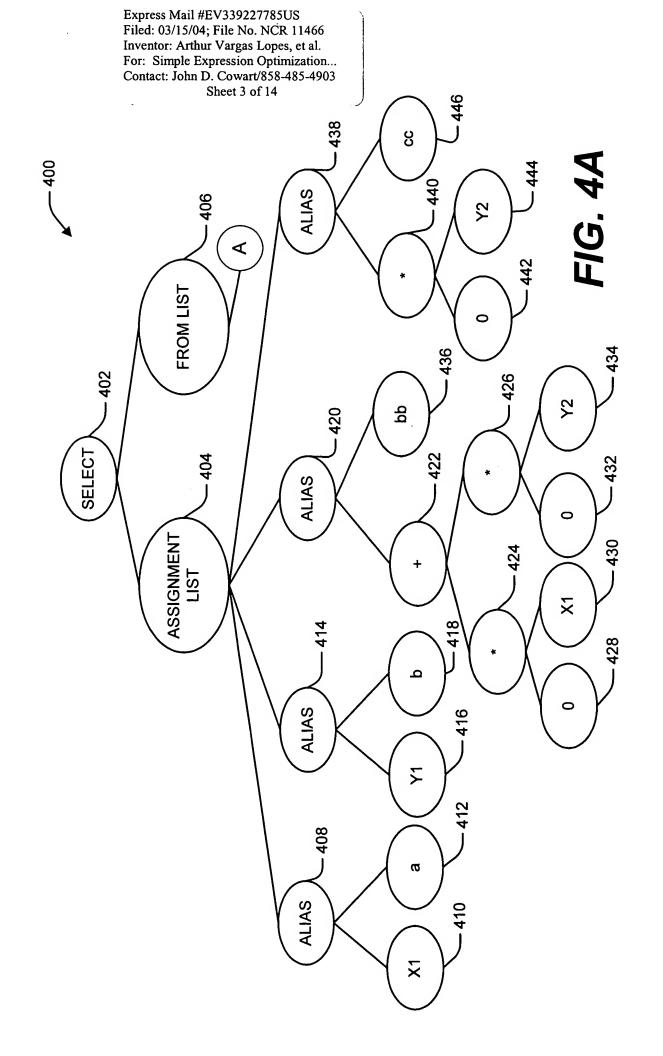Contact: John D. Cowart/858-485-4903
Sheet 4 of 14

A

LEFT
OUTER
JOIN —— 448

INNER
TABLE
LIST —— 450

OUTER
TABLE
LIST —— 454

ON —— 458

TA1 —— 452

TA2 —— 456

= —— 460

X1 —— 462

X2 —— 464

FIG. 4B

TREE,
CLAUSE TYPE — 505

— 500

KIND =
{+, -, *, /,MOD}
? — 510

Y → SCAN {+,-,*,/,MOD}
EXPRESSION — 515

N

KIND =
SELECT
? — 520

Y → SCAN SELECT CLAUSE — 525

N

KIND =
UPDATE OR
INSERT
? — 530

Y → SCAN UPDATE OR INSERT
CLAUSE — 535

N

KIND =
ALIAS
? — 540

Y → SCAN ALIAS CLAUSE — 545

N

KIND =
FUNCTION CALL
? — 550

Y → SCAN FUNCTION CALL
EXPRESSION — 555

N

RETURN
TREE — 560

FIG. 5

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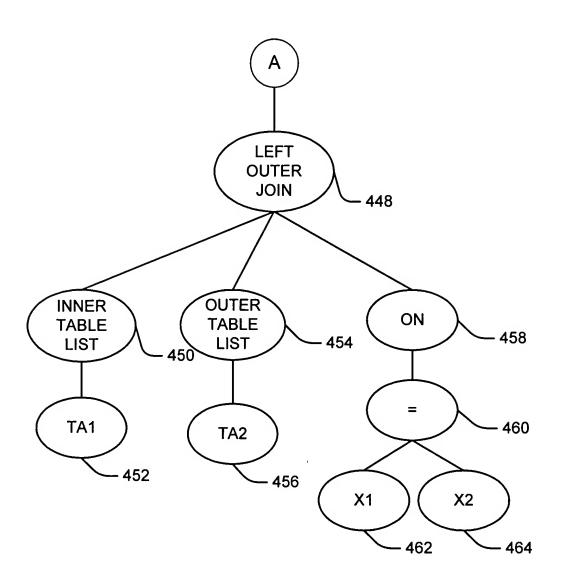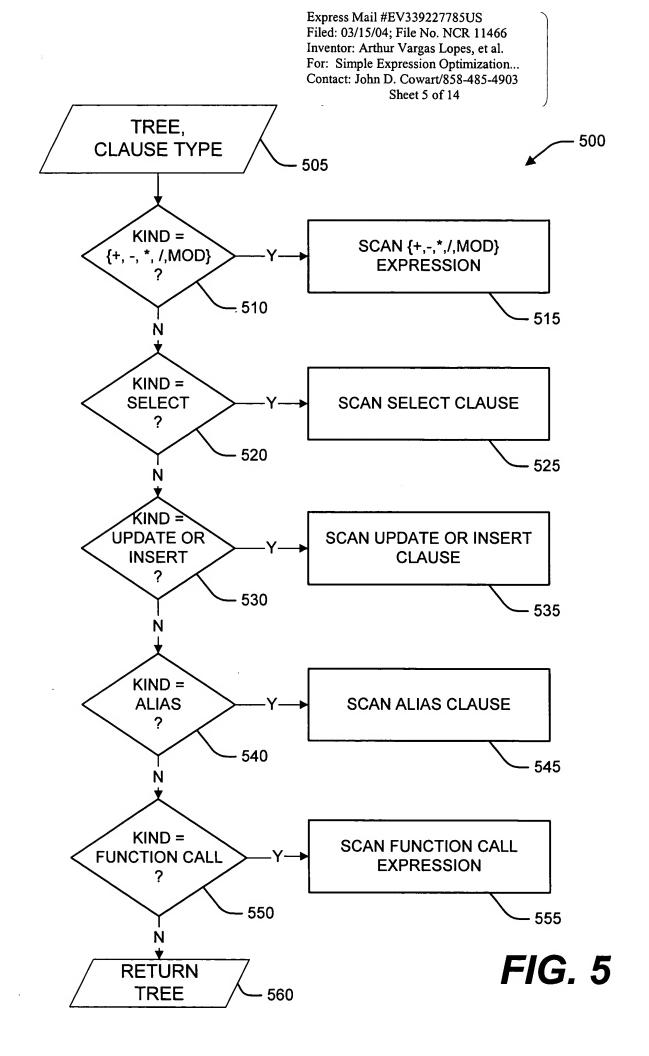Contact: John D. Cowart/858-485-4903
Sheet 6 of 14

515

SCAN(LEFT EXPRESSION, CLAUSE TYPE) — 320

SCAN(RIGHT EXPRESSION, CLAUSE TYPE) — 320

CLAUSE TYPE = ASSIGNMENT LIST ? — 605

Y → IN ALIAS LIST? — 615

N

N

Y

PRUNE(TREE, TREE TYPE) — 610
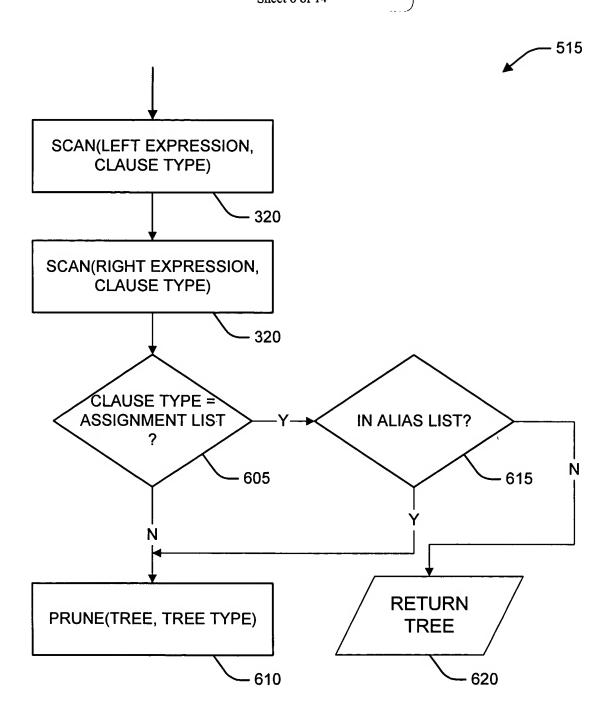
RETURN TREE — 620

FIG. 6

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Sheet 7 of 14

525

PUSH(CURRENT, TREE)

705

FOR EACH CLAUSE IN STATEMNT:

710

SCAN(CLAUSE, CLAUSE TYPE)

320

LOOP

715

POP(CURRENT, TREE)

720

RETURN TREE

725

FIG. 7

535

FOR EACH CLAUSE IN
STATEMNT:

805

SCAN(CLAUSE, CLAUSE
TYPE)

320

LOOP

810

RETURN
TREE

815

FIG. 8

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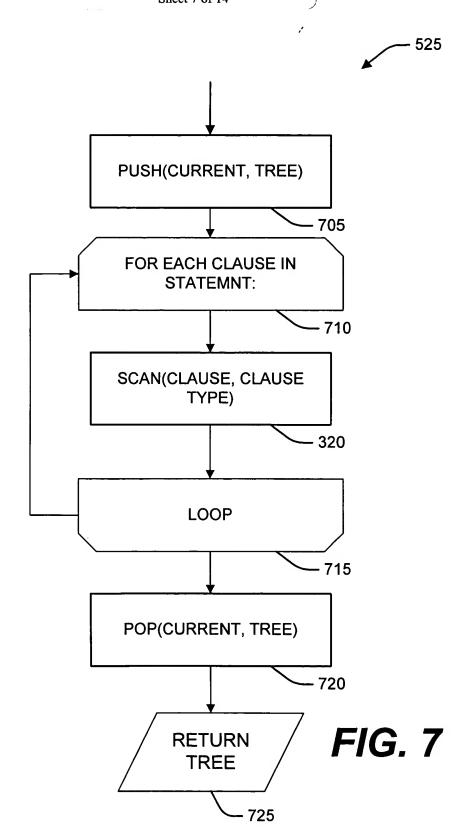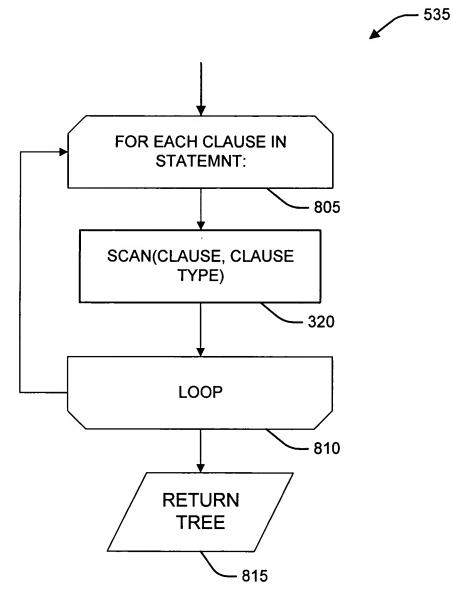Contact: John D. Cowart/858-485-4903
Sheet 9 of 14

545

```
┌─────────────────────────────┐
│                             │
│   WITHIN CONVERSION += 1    │
│                             │
└─────────────────────────────┘
                              └─ 905
              │
              ▼
┌─────────────────────────────┐
│   SCAN(LEFT EXPRESSION,     │
│       CLAUSE TYPE)          │
└─────────────────────────────┘
                              └─ 320
              │
              ▼
┌─────────────────────────────┐
│   SCAN(RIGHT EXPRESSION,    │
│       CLAUSE TYPE)          │
└─────────────────────────────┘
                              └─ 320
              │
              ▼
┌─────────────────────────────┐
│   WITHIN CONVERSION += 1    │
│                             │
└─────────────────────────────┘
                              └─ 910
              │
              ▼
       ╱─────────────╲
      │  RETURN       │
      │  TREE         │
       ╲─────────────╱
                       └─ 915
```
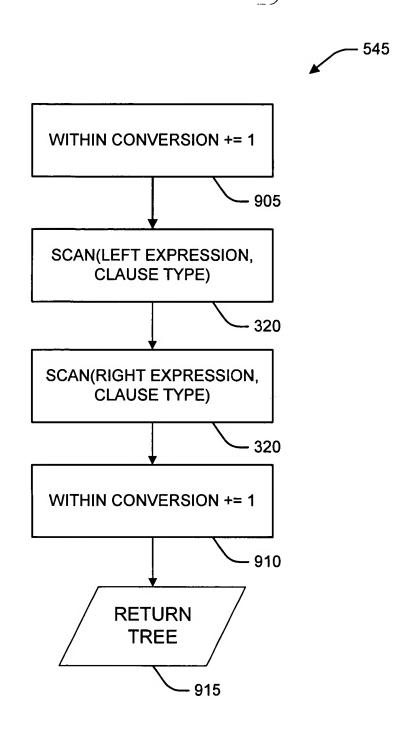
FIG. 9

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For: Simple Expression Optimization...
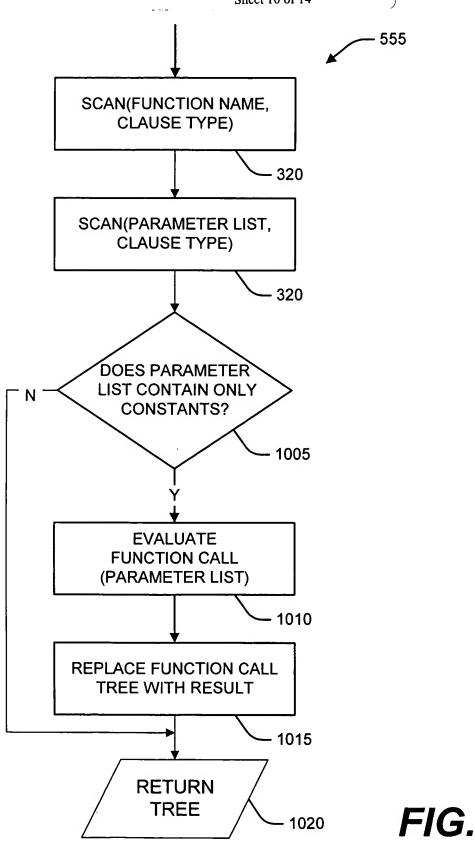Contact: John D. Cowart/858-485-4903
Sheet 10 of 14

555

SCAN(FUNCTION NAME,
CLAUSE TYPE)

— 320

SCAN(PARAMETER LIST,
CLAUSE TYPE)

— 320

DOES PARAMETER
LIST CONTAIN ONLY
CONSTANTS?

— 1005

N

Y

EVALUATE
FUNCTION CALL
(PARAMETER LIST)

— 1010

REPLACE FUNCTION CALL
TREE WITH RESULT

— 1015

RETURN
TREE

— 1020

FIG. 10

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For: Simple Expression Optimization...
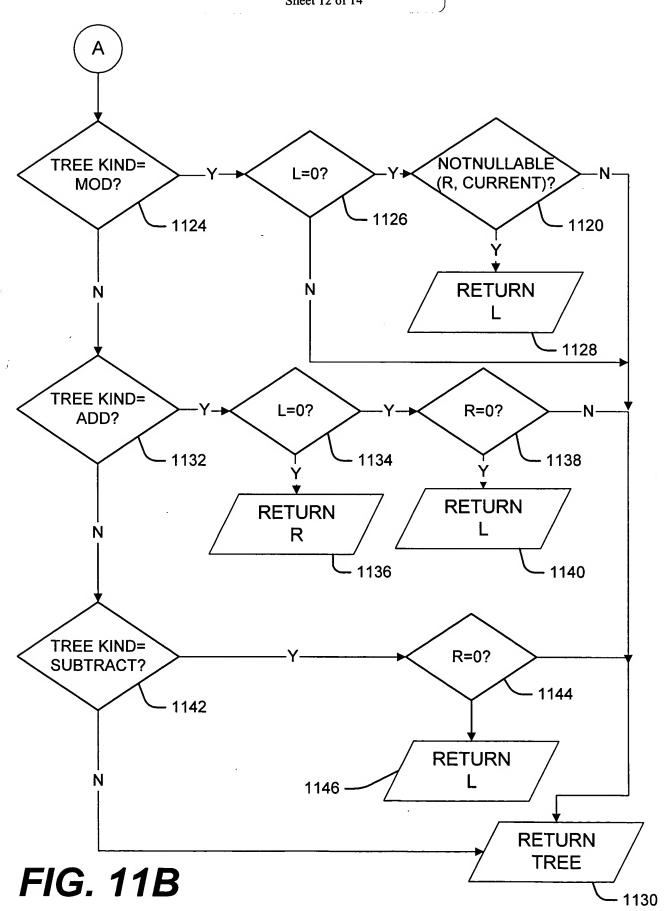Contact: John D. Cowart/858-485-4903
Sheet 11 of 14

610

TREE, CURRENT — 1002

↓

COPY LEFT EXPRESSION TO L — 1104

↓

COPY RIGHT EXPRESSION TO R — 1106

↓

TREE KIND= MULTIPLY? — 1108 —Y→ **EVALUATE MULITIPLY CLAUSE** — 1110

N
↓

TREE KIND= DIVIDE? — 1112 —Y→ **R=1?** — 1114 —N→ **L=0?** — 1118 —N→

N
↓

(A)

R=1? Y↓

RETURN L — 1116

L=0? Y↓

NOTNULLABLE (R, CURRENT) ? — 1120 —Y→ RETURN L

N
↓

RETURN TREE — 1110

FIG. 11A

A

TREE KIND=
MOD? — Y → L=0? — Y → NOTNULLABLE
(R, CURRENT)? — N →

1124   1126   1120

N   N   Y

RETURN
L

1128

TREE KIND=
ADD? — Y → L=0? — Y → R=0? — N →

1132   1134   1138

N   Y   Y

RETURN
R

RETURN
L

1136   1140

TREE KIND=
SUBTRACT? — Y → R=0?

1142   1144

N   Y

RETURN
L

1146

RETURN
TREE

FIG. 11B

1130

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Sheet 13 of 14

1110

FIG. 12

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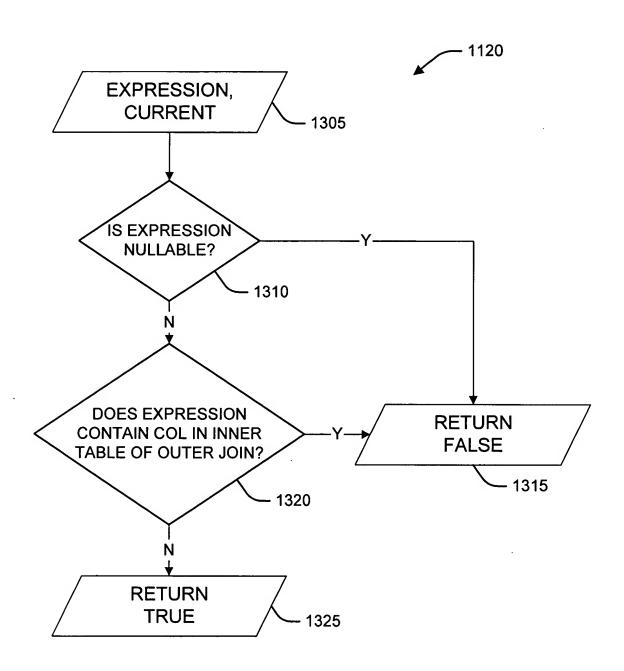Contact: John D. Cowart/858-485-4903
Sheet 14 of 14

1120

EXPRESSION,
CURRENT
1305

IS EXPRESSION
NULLABLE?
1310

Y

N

DOES EXPRESSION
CONTAIN COL IN INNER
TABLE OF OUTER JOIN?
1320

Y

RETURN
FALSE
1315

N

RETURN
TRUE
1325

FIG. 13